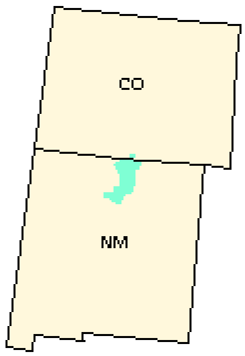
TOTAL MAXIMUM DAILY LOAD FOR TURBIDITY, STREAM BOTTOM DEPOSITS AND TOTAL PHOSPHORUS for Cordova Creek



Summary Table

New Mexico Standards Segment	Rio Grande 2120
Waterbody Identifier	Cordova Creek from mouth on Costilla to headwaters URG1-30300
Parameters of Concern	Turbidity, Stream Bottom Deposits, and Total Phosphorus
Uses Affected	High Quality Coldwater Fishery
Geographic Location	Upper Rio Grande Basin
Scope/size of Watershed	9 mi^2
Land Type	Ecoregions: Southern Rockies (211)
Land Use/Cover	Forest (81%), Rangeland (11%), Agriculture (4%), Urban (4%)
Identified Sources	Road Maintenance/Runoff, Recreation, Removal of Riparian Vegetation, Streambank Modification/Destabilization, Rangeland, and Land Development
Watershed Ownership	Private (100%)
Priority Ranking	4
Threatened and Endangered Species	None
TMDL for: Turbidity (as TSS) Stream Bottom Deposits Total Phosphorus	 WLA(0) + LA(607) + MOS(203)= **810 lbs/day** WLA(0) + LA (15) + MOS(5)= **20% fines** WLA(0) + LA (1.1) + MOS(0.4)= **1.5 lbs/day**

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to develop TMDL management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources at a given flow. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions.

Cordova Creek is located in the Upper Rio Grande Basin, located in northcentral New Mexico. Stations were located along Cordova Creek to evaluate the impact of land use activities on the water quality in Cordova Creek. As a result of this monitoring effort, several exceedances of New Mexico water quality standards for turbidity, stream bottom deposits (SBD), and total phosphorus (TP) were documented. Stream bottom deposits were assessed using techniques in the SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (SWQB/NMED 1999a). Some level of impairment due to embeddedness was documented. This Total Maximum Daily Load (TMDL) document addresses these three constituents.

A general implementation plan for activities to be established in the watershed is included in this document. The Surface Water Quality Bureau's Nonpoint Source Pollution Section will further develop the details of this plan. Implementation of recommendations in this document will be done with full participation of all interested and affected parties. During implementation, additional water quality data will be generated. As a result, targets will be re-examined and potentially revised; this document is considered to be an evolving management plan. In the event that new data indicate that the targets used in this analysis are not appropriate or if new standards are adopted, the load capacity will be adjusted accordingly. When water quality standards have been achieved, the reach will be removed from the TMDL list.

List of Abbreviations

BMP	**Best Management Practice**
CFS	**Cubic Feet per Second**
CWA	**Clean Water Act**
CWAP	**Clean Water Action Plan**
CWF	**Coldwater Fishery**
EPA	**Environmental Protection Agency**
FS	**United States Department of Agriculture Forest Service**
HQCWF	**High Quality Coldwater Fishery**
ISI	**Interstitial Space Index**
LA	**Load Allocation**
MGD	**Million Gallons per Day**
mg/L	**Milligrams per Liter**
MOS	**Margin of Safety**
MOU	**Memorandum of Understanding**
NMED	**New Mexico Environment Department**
NMSHD	**New Mexico State Highway and Transportation Department**
NPDES	**National Pollutant Discharge Elimination System**
NPS	**Nonpoint Source**
NTU	**Nephelometric Turbidity Units**
SBD	**Stream Bottom Deposits**
SWQB	**Surface Water Quality Bureau**
TMDL	**Total Maximum Daily Load**
TSS	**Total Suspended Solids**
UWA	**Unified Watershed Assessment**
WLA	**Waste Load Allocation**
WQLS	**Water Quality Limited Segment**
WQCC	**New Mexico Water Quality Control Commission**
WQS	**Water Quality Standards (20 NMAC 6.1)**

Background Information

Cordova Creek is located in the Upper Rio Grande Basin, located in northcentral New Mexico. This 9 mi^2 watershed is dominated by forest (Figure 1) on private land (Figure 2). The Carson National Forest borders property on the south and east, and the towns of Amalia and Costilla lie slightly to the north and west. The Cordova creek drainage basin is characterized by several small ephemeral creeks, which join to form Cordova Creek. Surface water quality monitoring stations were used to characterize the water quality of the stream reaches. As a result of this monitoring effort, several exceedances of New Mexico water quality standards for turbidity, stream bottom deposits, and total phosphorus were documented. Stream bottom deposits were assessed using techniques in the SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (SWQB/NMED 1999a). Some level of impairment due to embeddedness was seen on this reach.

Endpoint Identification

Target Loading Capacity

Target values for turbidity, stream bottom deposits, and total phosphorus will be determined based on 1) the presence of numeric criteria, 2) the degree of experience in applying the indicator and 3) the ability to easily monitor and produce quantifiable and reproducible results.

The designated uses for Cordova Creek are: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact. The standards are as follows:

1. In any single sample: conductivity shall not exceed 400umhos (500 umhos for the Rio Fernando de Taos), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20 C (68 F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2120.A.
2. The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 ml; no single sample shall exceed 200/100 ml (see Section 1103.B) (NMWQCC 1995).

The general standard for turbidity reads: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that desirable aquatic life presently common in New Mexico waters is inhibited or that will cause substantial visible contrast with the natural appearance of the water. Turbidity attributable to natural causes or the reasonable operation of irrigation and flood control facilities is not subject to these standards (NMWQCC 1995).

The general standard for stream bottom deposits reads: The stream shall be free of water contaminants from other than natural causes that will settle and adversely inhibit the growth of normal flora and fauna or significantly alter the physical or chemical properties of the bottom. Siltation resulting from the reasonable operation and maintenance of irrigation and flood control facilities is not subject to these standards (NMWQCC 1995).

Figure 1

Figure 2

There is no general standard for total phosphorus. In this case, the standard is specific to the designated use of a high quality coldwater fishery (HQCWF). Therefore, the numeric criterion for total phosphorus is 0.1 mg/L for Cordova Creek.

Turbidity
The State's standard leading to an assessment of use impairment is the numeric criteria for turbidity of 25 NTU for a HQCWF. Turbidity levels can be inferred from studies that monitor total suspended sediment (TSS) concentrations. Extrapolation from these studies is possible because of the relationship between concentrations of suspended sediments and turbidity (Appendix A). Activities that generate varying amounts of suspended sediment will proportionally change or affect turbidity (USEPA 1991).

Stream Bottom Deposits
The Surface Water Quality Bureau (SWQB) has compiled techniques to measure the level of embeddedness of a stream bottom in a SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (SWQB/NMED 1999a). This document addresses the narrative criteria for stream bottom deposits (SBD). The purpose of the Protocol is to provide a reproducible quantification of the narrative criteria for stream bottom deposits (SBD). The impact of fine sediment deposits is well documented in the literature. USEPA (1991) states that "An increased sediment load is often the most important adverse effect of ....activities on streams." This impact is largely a mechanical action, which severely reduces the available habitat for macroinvertebrates and fish species, which utilize the streambed in various life stages. An increase in suspended sediment concentrations will reduce the penetration of light, decreases the ability of fish on fingerlings to capture prey, and reduce primary production (US EPA 1991). The SWQB Sediment Workgroup evaluated a number of methods described in the literature that would provide information allowing a direct assessment of the impacts to the stream bottom substrate. A final list of monitoring procedures was implemented at a wide variety of sites during the 1998-monitoring season. These procedures included conducting pebble counts (a measurement of % fines), stream bottom cobble embeddedness, Rosgen (1996) fluvial geomorphology, and various biological measures.

The SWQB examined two ways to base the target levels for stream bottom deposits. The first is the nominal stream morphology for the specific stream type (Rosgen 1996). Using the Rosgen approach, data collection at the impaired site included an evaluation of the stream geomorphology. Following this approach Cordova Creek was determined to be a B4 stream type. The target value for percent fines for a B4 stream type is 20%(Rosgen 1996). A disadvantage of Rosgen's approach is that it is not based on streams in New Mexico and is based on the existing condition of the stream, not a desired or "natural" stream type.

The second way to base the target levels involved the examination of developed relationships between embeddedness, fines, and biological score. Using existing data from New Mexico, a strong relationship (R^2=0.7511) was established between embeddedness and the biological scores from the SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (SWQB/NMED 1999a) sampling from 1998 (Appendix B). A strong correlation (R^2= 0.719) was also found when relating embeddedness to percent fines (Appendix B). These relationships show that at the desired biological score (at least 70, per the SWQB Assessment Protocol 1998) the target embeddedness (for fully supporting a designated use) would be 45%, and the target fines would be 20%. Since this relationship is based on New Mexico streams (and confirms the Rosgen target value) it was chosen for the target value for percent fines.

Total Phosphorus
The standard leading to an assessment of use impairment is the numeric criteria for total phosphorus (TP) of 0.1 mg/L for a High Quality Coldwater Fishery (HQCWF). Any unbound phosphate ions that enter into streams are readily taken up by aquatic plants and microorganisms. The rapid biological uptake and ease of chemical bonding explain why phosphate concentrations in natural waters are very low (EPA 1991). The chemistry of phosphorus is such that most of the phosphorus entering into aquatic systems will be either sorbed onto soil particles or incorporated into organic compounds. Thus, soil erosion can be a primary source of phosphorus entering a waterbody (EPA 1991). A strong correlation exists between TSS and Total Phosphorus (TP) using a linear regression of the Cordova Creek data (R^2=0.76)(Appendix C). Therefore, total phosphorus concentrations in the stream are likely linked to sediment loading.

Flow
Sediment movement in a stream varies as a function of flow. As flow increases the concentration of sediment increases. This TMDL is calculated for each reach at a specific flow. When available, US Geologic Survey gages are used to estimate flow. Where gages are absent, geomorphological cross sectional information is taken at each site and the flows are modeled. In this case, gaged streamflow data is not available for Cordova Creek. Stream flow data for Cordova Creek consists of actual flow measurements taken by NMED staff. These measurements were taken during low flow periods using a standard pygmy flow meter. Additionally, cross sectional data was taken in order to estimate stream discharge using procedures from USGS Technical paper 2193, *Streamflow Characteristics related to Channel Geometry of Streams in Western United States* (USGS 1982*),* and the channel cross-section analyzer WinXSPRO® (FS 1998).

Following USGS (1982) average discharge is calculated using the regression equation in Equation 1. $Q_A=64W_{ac}^{1.88}$

Q_A=acre-feet/yr, W_{ac}=width of the active channel (width at bankfull) (Appendix D)

Utilizing the Cordova Creek cross section in Appendix E, the width of Cordova Creek at bankfull is 6.5ft. Applying Equation 1 yields a calculated volume or flow of 2,160 acre/feet per year or 2.96 cfs (Appendix F).
$Q_A=64(6.5)^{1.88}$
Q_A=2,160 acre feet/year
=2.96 cfs (+/-.20) (standard error +/-28%)

With a standard error of +/-28%, the estimated average discharge ranges from 2.76-3.16 cfs. This calculation overlaps with the WinXSPRO® model calculated @ 1/3 bankfull depth (2.83cfs) for an estimate of average daily flow according to Leopold et al. (1994, 1964) (Appendix F).

Target and measured loads will for total phosphorus and turbidity(expressed as TSS) in lbs/day will be calculated from the lower end of the standard error of the estimated mean average discharge for Cordova Creek 2.76 cfs (Appendix F). Average discharge is defined as that flow rate which if continued every day of the year, would yield the observed annual volume of water. The average discharge usually fills a channel to approximately one-third of the channel depth, and this flow rate is equaled or exceeded approximately 25% of the days in a year (Leopold et al. 1964). Average discharge is characterized by five attributes, which make it ideal for TMDL modeling:

1. Approximately 75% of the time, flows are less than the average discharge.
2. Volume carried by these flows amounts to only 25% of the annual volume.
3. It can be easily modeled.
4. It's the discharge average for 365 days (one year).

The cross section of the channel and adjacent floodplain is key to predict velocity and water surface stage elevation during high and low flow events. It is important to remember that the TMDL is a planning tool to be used to achieve water quality standards. Since flows vary throughout the year in these systems the target load will vary based on the changing flow. Management of the load should set a goal at water quality standards attainment; not meeting the calculated target load.

*Calculation*s

Target loads for turbidity (expressed as TSS) and total phosphorus are calculated based on a flow, the current water quality standards, and a unit less conversion factor, 8.34 that is a used to convert mg/L units to lbs/day (see Appendix G for Conversion Factor Derivation). The target loading capacity is calculated using Equation 1.

Equation 2. critical flow (mgd) x standard (mg/L) x 8.34 (conversion factor) = target loading capacity

The target loads (TMDLs) predicted to attain standards were calculated using Equation 2 and are shown in Table 1.

Table 1: Calculation of Target Loads

Location	Flow^	Standards			Conversion	Target Load
□	(mgd)	TSS* (mg/L)	Stream Bottom Deposits (%fines)	Total Phosphorus (mg/L)	Factor	Capacity
Cordova Creek	1.8 1.8	54	□20	 0.1	8.34 8.34	810 (lbs/day) 20 (% fines) 1.5 (lbs/day)

^Since a USGS gage was unavailable on this reach, flow is modeled using a cross sectional data that is used to estimate stream discharge using USGS Technical paper 2193 (USGS 1982) and the channel cross-section analyzer WinXSPRO® (USDA-FS 1998).

*This value is calculated using the relationship established between TSS and turbidity (y=1.9931x+3.7586) R^2=0.969(Appendix A). The turbidity standard is 25 NTU.

** This value is based on a narrative standard. The background values for stream bottom deposits were taken from the SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (1999a).

The measured loads were calculated using Equation 1. In order to achieve comparability between the target and measured loads, the flows used were the same for both calculations. The geometric mean of the data that exceeded the standards from the data collected at each site was substituted for the standard in Equation 1. The same conversion factor of 8.34 was used. Results are presented in Table 2.

Background loads were not possible to calculate in this watershed. A reference reach, having similar stream channel morphology and flow, was not found. It is assumed that a portion of the load allocation is made up of natural background loads. In future water quality surveys, finding a suitable reference reach will be a priority.

Table 2: Calculation of Measured Loads

Location	Flow^ (mgd)	Geometric Means			Conversion Factor	Measured Load Capacity
		TSS* (mg/L)	SBD** (% fines)	TP (mg/L)		
Cordova Creek	1.8	326			8.34	4894 (lbs/day)
			27			27% fines
	1.8			0.24	8.34	3.6 (lbs/day)

^Since a USGS gage was unavailable on this reach, flow is modeled using a cross sectional data that is used to estimate stream discharge using USGS Technical paper 2193 (USGS 1982) and the channel cross-section analyzer WinXSPRO® (USDA-FS 1998).
*TSS measured during periods when the turbidity standards were exceeded and the geometric mean was calculate from these values.
** This value was calculated using values at three stations across the entire reach.

Waste Load Allocations and Load Allocations

•*Waste Load Allocation*

There are no point source contributions associated with this TMDL. The waste load allocation is zero.

•*Load Allocation*

In order to calculate the Load Allocation (LA) the waste load allocation and margin of safety (MOS) were subtracted from the target capacity (TMDL) following Equation 2.

Equation 2. $WLA + LA + MOS = TMDL$

Results are presented in Table 3a (Calculation of TMDLs for Turbidity), Table 3b (Calculation of TMDLs for Stream Bottom Deposits), and Table 3c (Calculation of TMDL for Total Phosphorus).

Table 3a: Calculation of TMDL for Turbidity

Location	WLA (lbs/day)	LA (lbs/day)	MOS (25%) (lbs/day)	TMDL (lbs/day)

Cordova Creek	0	607	203	810

Table 3b: Calculation of TMDL for Stream Bottom Deposits

Location	WLA (% fines)	LA (% fines)	MOS (25%) (% fines)	TMDL (% fines)
Cordova Creek	0	15	5	20

Table 3c: Calculation of TMDL for Total Phosphorus

Location	WLA (lbs/day)	LA (lbs/day)	MOS (25%) (lbs/day)	TMDL (lbs/day)
Cordova Creek	0	1.1	.4	1.5

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the target load (Table 1) and the measured load (Table 2), and are shown in Table 4 (Calculation of Load Reductions).

Table 4: Calculation of Load Reductions

Location	Target Load			Measured Load			Load Reductions		
	TSS (lbs/day)	SBD (%fines)	TP (lbs/day)	TSS (lbs/day)	SBD (%fines)	TP (lbs/day)	TSS (lbs/day)	SBD (% fines)	TP (lbs/day)
Cordova Creek	607	15	1.1	4894	27	3.6	4287	12	2.5

Identification and Description of pollutant source(s)

Table 5: Pollutant Source Summary

Pollutant Sources	**Magnitude** (Load Allocation + MOS)	**Location**	**Potential Sources*** (% from each)
Point: None	0	--------	0%
Nonpoint: •Sediment Turbidity (as TSS in lbs/day) Stream Bottom Deposits (% fines) Total Phosphorus (lbs/day)		Cordova Creek	100% Road Maintenance/Runoff Recreation Streambank Modification/Destabilization Removal of Riparian Vegetation Rangeland Land Development

Linkage of Water Quality and Pollutant Sources

Where available data are incomplete or where the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information.

SWQB fieldwork includes an assessment of the potential sources of impairment (SWQB/NMED 1999b). The Pollutant Source(s) Documentation Protocol, shown as Appendix H, provides an approach for a visual analysis of the source along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Table 5 (Pollutant Source Summary) identifies and quantifies potential sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment. A further explanation of the sources follows.

Pollutant Sources on Cordova Creek
The main sources of impairment along this reach appear to be road maintenance, runoff and recreation activities. Starting at its headwaters on Ski Rio property, Cordova Creek has serious erosion and sediment loading due to loss of riparian vegetation and streambank destabilization. Cordova Creek flows through Ski Rio (developed in 1982) and has been modified to flow directly alongside the road leading to Highway 196. The road is crowding the stream against the embankments leading to serious erosion and sediment inputs into the creek. Parking lot and road runoff is most likely contributing to the sediment load. The soil types along Cordova Creek include the Amalia-Manzano Association and the Marosa-Nambe Association. Water erosion is a moderate hazard for these soil types (USDA 1982).

The Ski Rio resort and areas adjacent to it are undergoing increased land development, which may be contributing to the sediment load in Cordova Creek. The clearing of land may increase sediment loading into the creek. Most existing and new structures are connected to a wastewater treatment system, which when properly functioning do not appear to be a contributing factor to the phosphorus load into Cordova Creek.

Elk and other wildlife are found throughout the watershed. These animals can represent a potentially important source of phosphate contributions. Animal waste can directly impair water quality through bacterial contamination and increasing nutrient levels. Domestic livestock grazing occurs throughout the watershed and may contribute to the phosphorus loading.

<u>Margin of Safety (MOS)</u>
TMDLs should reflect a margin of safety based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no margin of safety for point sources, since there are none. However, for the nonpoint sources the margin of safety is estimated to be an addition of **25%** of the TMDL. This margin of safety incorporates several factors:

- *Errors in calculating NPS loads*

  A level of uncertainty does exist in the relationship between TSS and turbidity. In this case, the TSS measure does not include bedload and therefore does not account for a complete measure of sediment load. This does not influence the MOS because we need only be concerned with the turbidity portion of the sediment load, which is the basis for the standard. A level of uncertainty exists in the relationship between background total phosphorus loading from natural and unknown sources. A majority of the watershed is on private land. The contribution of total phosphorus loading from domestic livestock grazing, land development, and other activities on private land is not clear. There is also a potential to have errors in measurements of nonpoint source loads due to equipment accuracy, time of sampling, etc. Accordingly, a conservative margin of safety increases the TMDL by **25%**.

•*Errors in calculating flow*

Flow estimates were based on estimated mean average discharge using USGS 1982 and cross sectional information utilizing WinXSPRO®. The critical flow is a conservative condition set to the estimated mean average discharge. The standard error of estimated mean average discharge is 28%. Conservative values were used to calculate loads and do not warrant additional MOS.

Consideration of seasonal variation

Data used in the calculation of this TMDL were collected during spring, summer, and fall in order to ensure coverage of any potential seasonal variation in the system. Since the critical condition is set to estimated mean average discharge, all data were used in determining the target capacities. Therefore, it can be assumed that if the critical condition is being met, coverage of any potential seasonal variation will also be met.

Monitoring Plan

Pursuant to Section 106(e)(1) of the Federal Clean Water Act, the SWQB has established appropriate monitoring methods, systems and procedures in order to compile and analyze data on the quality of the surface waters of New Mexico. In accordance with the New Mexico Water Quality Act, the SWQB has developed and implemented a comprehensive water quality monitoring strategy for the surface waters of the State. The monitoring strategy establishes the methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used to progress toward three basic monitoring objectives: to develop water quality-based pollution controls, to evaluate the effectiveness of such controls and to conduct water quality assessments.

The SWQB utilizes a rotating basin system approach to water quality monitoring. In this system, a select number of watersheds are intensively monitored each year with an established return frequency of every five years.

The SWQB maintains current quality assurance and quality control plans to cover all monitoring activities. This document "Quality Assurance Project Plan for Water Quality Management Programs" (QAPP) is updated annually.
Current priorities for monitoring in the SWQB are driven by the 303(d) list of streams requiring TMDLs. Short-term efforts are directed toward those waters which are on the EPA TMDL consent decree (Forest Guardians and Southwest Environmental Center v. Carol Browner, Administrator, US EPA, Civil Action 96-0826 LH/LFG, 1997) list and which are due within the first two years of the monitoring schedule. Once assessment monitoring is completed those reaches still showing impacts and therefore requiring a TMDL will be targeted for more intensive monitoring. The methods of data acquisition include fixed-station monitoring, intensive surveys of priority water bodies, including biological assessments, and compliance

monitoring of industrial, federal and municipal dischargers, and are specified in the Assessment Protocol (SWQB/NMED 1998).

Pebble counts are used to develop a particle size distribution curve of the bed surface material. The method described by Wolman (1954) was selected for inclusion in the parameter suite evaluated during the sample season. The advantage of this procedure is that it is relatively quick to perform and is reproducible. In streams dominated by fine sediments, coarser particles that provide beneficial habitat tend to become surrounded or buried in fines leading to a loss of suitable habitat. Cobble embeddedness is a measure of the extent to which these coarser particles are buried by these finer sediments and has both biological and physical significance (USEPA 1991). The sampling procedure chosen for New Mexico streams is that devised by Skille and King (1989). This technique uses 60-cm diameter hoops as the basic sampling unit. The use of hoops rather than individual particles as the basic unit of measure reduces the variability of the sample. Software obtained from the Idaho Bureau of Reclamation allows for the evaluation of the data (Burton 1990). Values calculated and reported by the software are percent embeddedness, the Interstitial Space Index (ISI), and percent free matrix cobble. Also available in the software is a sample size evaluator that helps in determinations of whether sufficient sample size has been collected to statistically define the population. The advantage of this procedure is that it is quantifiable. The major disadvantage is in the substantial effort required to complete the data collection.

Long term monitoring for assessments will be accomplished through the establishment of sampling sites that are representative of the waterbody and which can be revisited every five years. This gives an unbiased assessment of the waterbody and establishes a long term monitoring record for simple trend analyses. This information will provide time relevant information for use in 305(b) assessments and to support the need for developing TMDLs.

This approach provides:

- a systematic, detailed review of water quality data and allows for efficient use of monitoring resources.
- information at a scale where implementation of corrective activities is feasible.
- an established order of rotation and predictable sampling in each basin, which allows for enhanced coordinated efforts with other programs.
- program efficiency and improves the basis for management decisions.

It should be noted that a basin will not be ignored during its four year sampling hiatus. The rotating basin program will be supplemented with other data collection efforts, which will be classified as field studies. This time will be used to analyze the data collected, conduct field studies to further characterize identified problems, and develop and implement TMDLs. Both types of monitoring, long term and field studies, can contribute to the §305(b) and §303(d) listing processes.

The following schedule is for sampling seasons through 2002 and will be done in a consistent manner to support the New Mexico Unified Watershed Assessment (UWA) and the Nonpoint Source Management Program. This sampling regime allows characterization of seasonal variation through sampling in spring, summer, and fall for each of the watersheds.

1998 - Jemez, Chama (above El Vado), Cimarron (above Springer), Santa Fe, San Francisco

1999 - Chama (below El Vado), middle Rio Grande, Gila, Red River
2000 - Mimbres, Dry Cimarron, upper Pecos (headwaters to Ft. Sumner), upper Rio Grande (part1)
2001 - Upper Rio Grande (part 2), lower Pecos (Roswell south), Closed Basins, Zuni
2002 - Canadian Basin, lower Rio Grande, San Juan, Rio Puerco

Implementation plan

Management Measures

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993). A combination of best management practices (BMPs) will be used to implement this TMDL. For this watershed the focus will be on sediment control. BMPs in this area will include proper road maintenance practices and drainage controls, riparian plantings, and hydrogeomorphic river restoration. The SWQB will work with the New Mexico State Highway and Transportation Department (NMSHD) and private landowners in implementing BMPs throughout the watershed.

Even with the implementation of numerous BMPs, Cordova Creek may not be able to meet water quality standards as a HQCWF. Another option for Cordova Creek may be a use attainability analysis to be conducted on this creek. A use attainability analysis is a scientific study, which shall be conducted only for the purpose of assessing the factors affecting the attainment of a use (NMWQCC 1995). A use attainability analysis (UAA) would determine whether Cordova Creek is actually meeting its designated use as a HQCWF.

Stakeholder and public outreach and involvement in the implementation of this TMDL will be ongoing. Stakeholder participation will include choosing and installing BMPs, as well as potential volunteer monitoring. Stakeholders in this process will include: SWQB, NMSHD, local government, private landowners, environmental groups, and the general public.

Time Line

Implementation Actions	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Public Outreach and Involvement	X	X	X	X	X
Establish Milestones	X				
Secure Funding	X		X		
Implement Management Measures (BMPs)		X	X		
Monitor BMPs		X	X	X	

Determine BMP Effectiveness				X	X
Re-evaluate Milestones				X	X

Assurances

New Mexico's Water Quality Act does not contain enforceable prohibitions directly applicable to nonpoint sources of pollution. The Act does authorize the Water Quality Control Commission to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution.

Nonpoint source water quality improvement work utilizes a voluntary approach. This provides technical support and grant money for the implementation of best management practices and other NPS prevention mechanisms through §319 of the Clean Water Act. Since this TMDL will be implemented through NPS control mechanisms the New Mexico Nonpoint Source Program is targeting efforts to this watershed. The Nonpoint Source Program coordinates with the Nonpoint Source Taskforce. The Nonpoint Source Taskforce is the New Mexico statewide focus group representing federal and state agencies, local governments, tribes and pueblos, soil and water conservation districts, environmental organizations, industry, and the public. This group meets on a quarterly basis to provide input on the Section 319 program process, to disseminate information to other stakeholders and the public regarding nonpoint source issues, to identify complimentary programs and sources of funding, and to help review and rank Section 319 proposals.

In order to ensure reasonable assurances for implementation in watersheds with multiple landowners, including Federal, State and private land, NMED has established MOUs with several Federal agencies, in particular the Forest Service and the Bureau of Land Management. MOUs have also been developed with other State agencies, such as the New Mexico Highway Department. These MOUs provide for coordination and consistency in dealing with nonpoint source issues.

New Mexico's Clean Water Action Plan has been developed in a coordinated manner with the State's 303(d) process. All Category I watersheds identified in New Mexico's Unified Watershed Assessment process are totally coincident with the impaired waters list for 1996 and 1998 approved by EPA. The State has given a high priority for funding assessment and restoration activities in these watersheds.

The time required to attain standards for all reaches in this watershed is estimated to be approximately 10-20 years. This estimate is based on a five-year time frame for implementation. Watershed projects will be started incrementally; a few projects are already established in response to earlier projects. The cooperation of private landowners and Federal Agencies will be pivotal in the implementation of this TMDL.

Milestones

Milestones will be used to determine if control actions are being implemented and standards attained. For this TMDL several milestones will be established that will vary based on the BMPs implemented at each site. Examples of milestones include a percentage reduction in stream bottom deposits within a certain time frame, update or develop MOUs with other state and federal agencies by 2001 to ensure protection and restoration in this watershed, and to increase education and outreach activities regarding sediment erosion in this watershed, particularly for private landowners.

Milestones will be reevaluated periodically, depending on what BMP was implemented. Further implementation of this TMDL will be revised based on this reevaluation. The process will involve monitoring pollutant loading, tracking implementation and effectiveness of controls, assessing water quality trends in the waterbody, and reevaluating the TMDL for attainment of water quality standards.

Public Participation

Public participation was solicited in development of this TMDL. See Appendix I for flow chart of the public participation process. The draft TMDL was made available for a 30-day comment period starting September 14, 1999. Response to comments is attached as Appendix J of this document. The draft document notice of availability was extensively advertised via newsletters, email distribution lists, webpage postings (http://www.nmenv.state.nm.us), and press releases to area newspapers.

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Appendices

Appendix A: Relationship between Turbidity and Total Suspended Sediment on Cordova Creek

Appendix B: SWQB/NMED draft Protocol for the Assessment of Stream Bottom Deposits (SWQB/NMED 1999a) Relationships

Appendix C: Relationship between Total Suspended Sediment and Total Phosphorus on Cordova Creek

Appendix D: Equation for Determining Mean Annual Runoff for Streams in the Western US

Appendix E: Cordova Creek Cross Section

Appendix F: Estimated Average Discharge for Cordova Creek

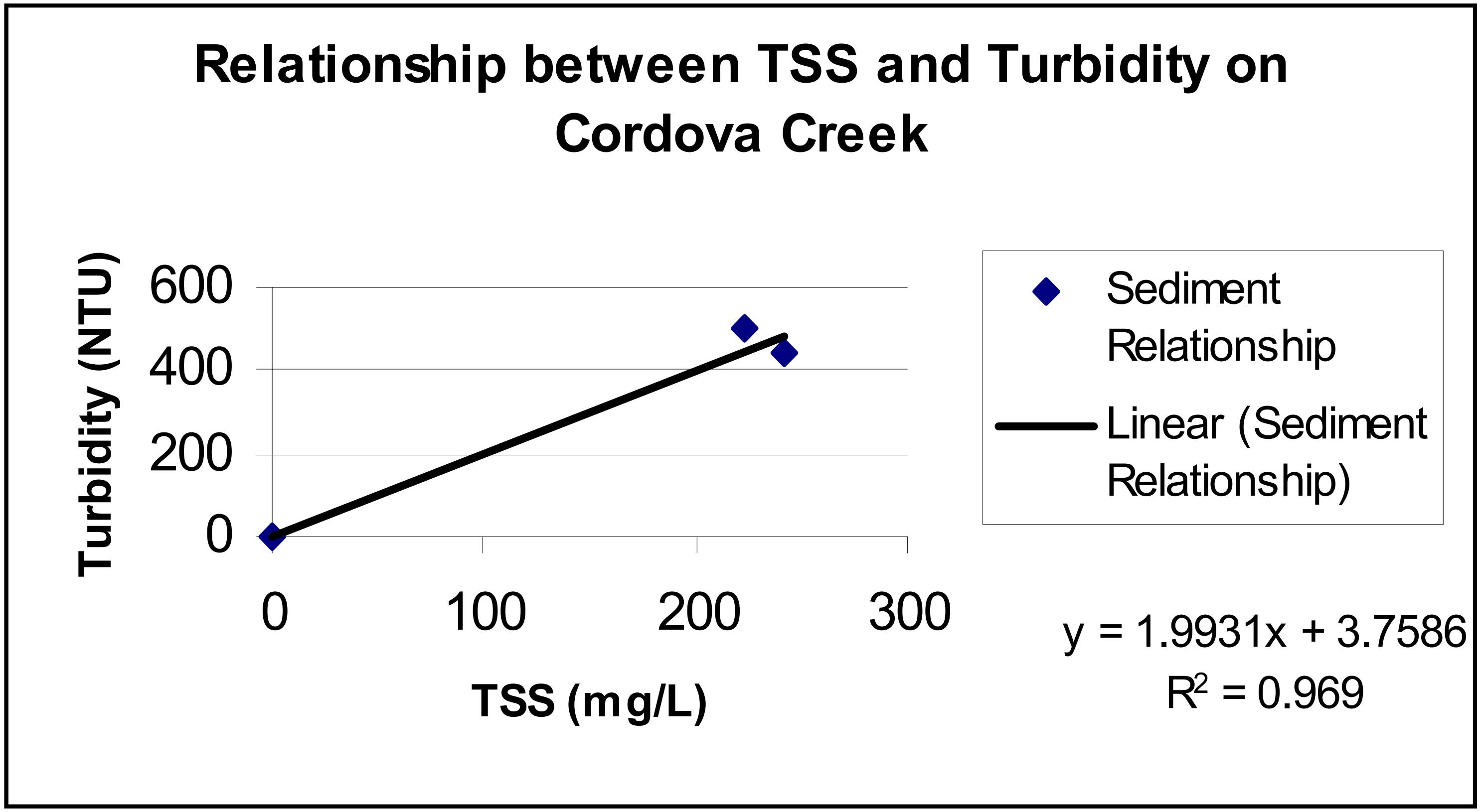
Appendix G: Conversion Factor Derivation

Appendix H: Pollutant Source(s) Documentation Protocol

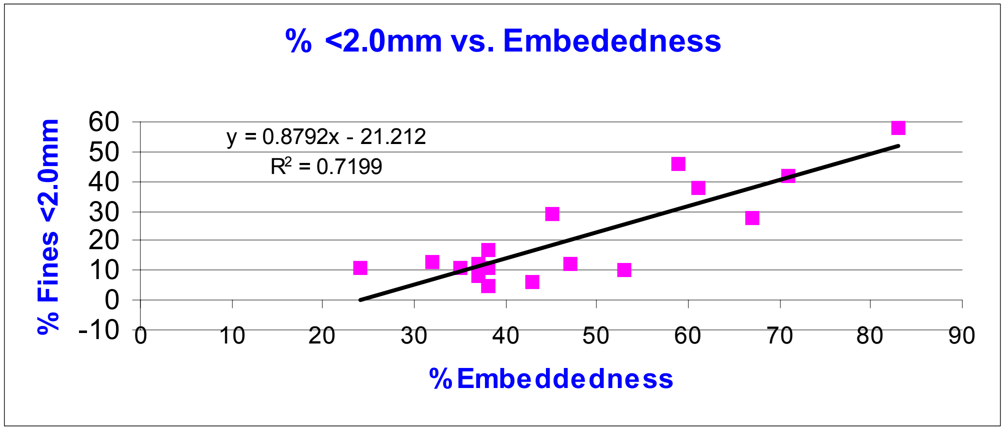
Appendix I: Public Participation Process Flowchart

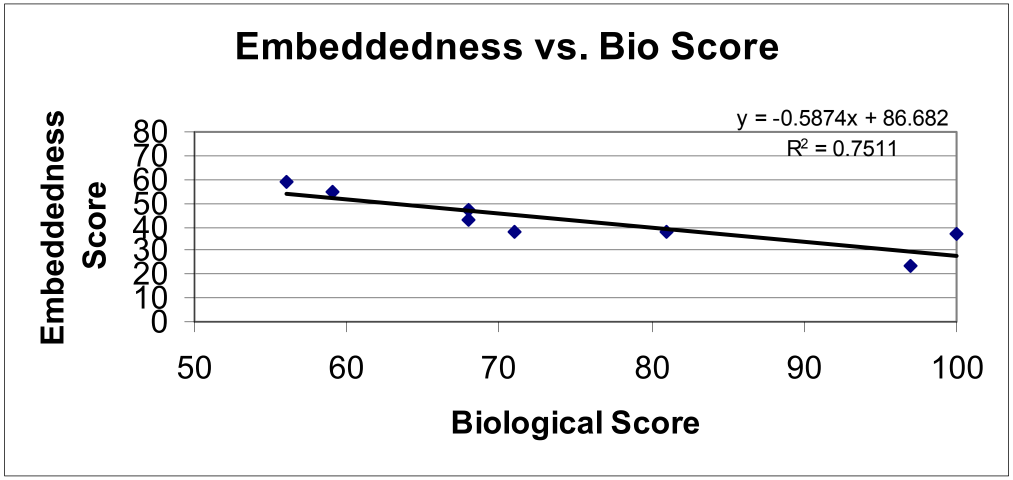
Appendix J: Response to Comments

Appendix A: Relationship between Turbidity and Total Suspended Sediment on Cordova Creek



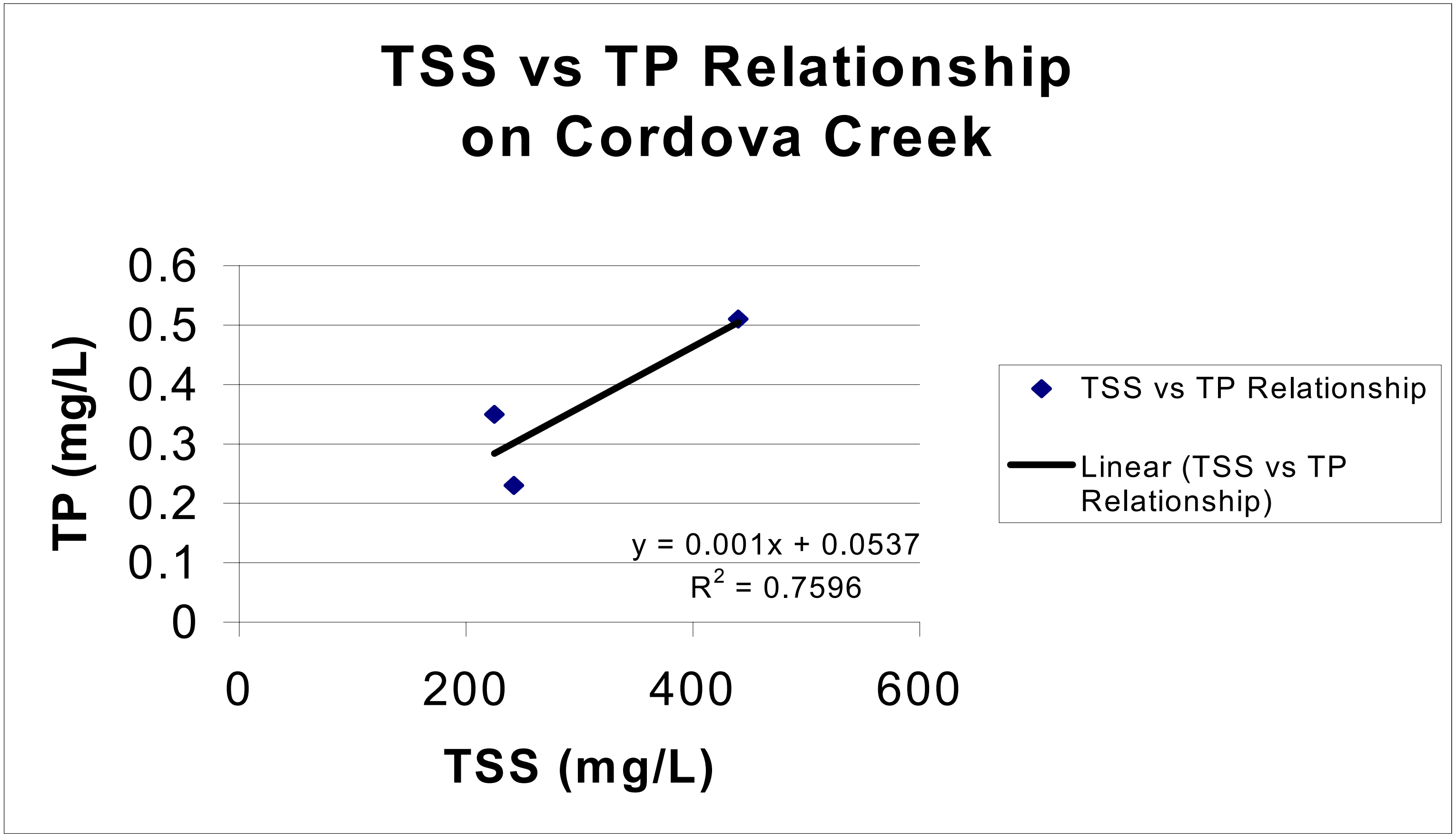
Hillside slumping caused by road construction on Cordova Creek 5/12/99


% <2.0mm vs. Embededness
y = 0.8792x - 21.212
R2 = 0.7199
% Fines <2.0mm
60
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
90
% Embeddedness


Embeddedness vs. Bio Score
y = -0.5874x + 86.682
R2 = 0.7511
Embeddedness Score
80
70
60
50
40
30
20
10
0
50
60
70
80
90
100
Biological Score

Mass wasting of the hillside on Cordova Creek 5/12/99

Appendix C: Relationship between Total Suspended Sediment and Total phosphorus on Cordova Creek

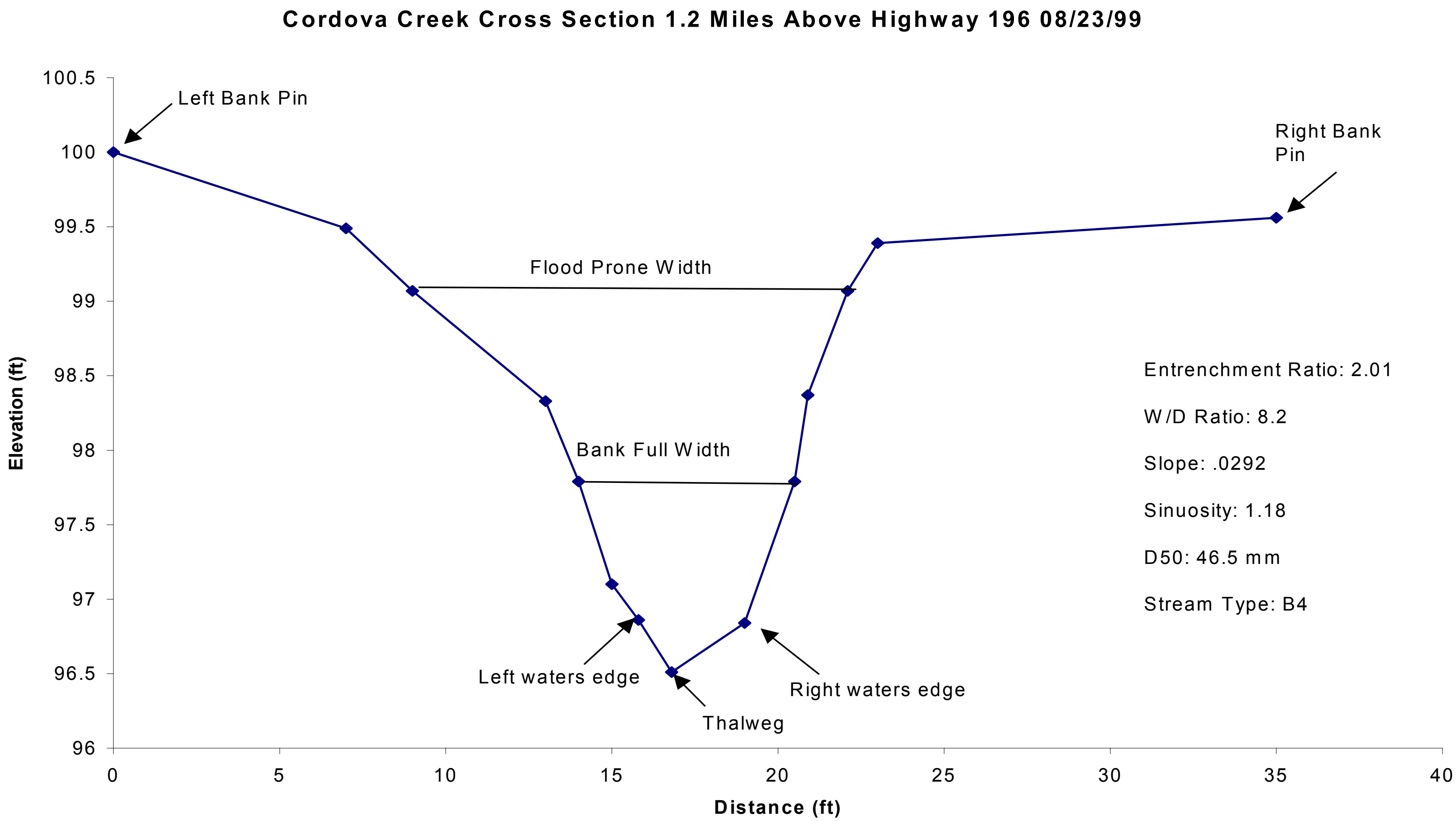


Upstream impoundment of Cordova Creek at Ski Rio 5/12/99

Erosion caused by the Cordova Creek impoundment at Ski Rio

Appendix D: Equation for Determining Mean Annual Runoff for Streams in the Western US

Appendix E: Cordova Creek Cross Section



THALWAG = the thread of the deepest water; **SINUOSITY** = stream length/valley length or valley slope/channel slope; E**NTRENCHMENT RATIO** = the degree of vertical containment of a river channel (width of the flood prone area at an elevation twice the maximum bankfull depth/bankfull width;

W/D RATIO = the shape of the channel cross-section (ratio of bankfull width/mean bankfull depth); **SLOPE** = slope of the water surface averaged for 20-30 channel widths

Appendix F: Estimated Average Discharge for Cordova Creek

Appendix G: Conversion Factor Derivation

8.34 Conversion Factor Derivation

Million gallons/day **x** Milligrams/liter **x** 8.34 = pounds/day

10^6 ~~gallons~~/day **x** 3.7854 liters/~~1 gallon~~ **x** 10^{-3} gram/liter **x** 1 pound/454 ~~grams~~ = pounds/day

10^6 (10^{-3}) (3.7854)/454 = 3785.4/454

= 8.3379
= **8.34**

Appendix H

POLLUTANT SOURCE(S) DOCUMENTATION PROTOCOL

This protocol was designed to support federal regulations and guidance requiring states to document and include probable source(s) of pollutant(s) in their §303(d) Lists as well as the States §305(b) Report to Congress.

The following procedure should be used when sampling crews are in the field conducting water quality surveys or at any other time field staff are collecting data.

Pollutant Source Documentation Steps:

1). Obtain a copy of the most current §303(d) List.

2). Obtain copies of the ***Field Sheet for Assessing Designated Uses and Nonpoint Sources of Pollution***.

3). Obtain 35mm camera that has time/date photo stamp on it. **DO NOT USE A DIGITAL CAMERA FOR THIS PHOTODOCUMENTATION**

4). Identify the reach(s) and probable source(s) of pollutant in the §303(d) List associated with the project that you will be working on.

5). Verify if current source(s) listed in the §303(d) List are accurate.

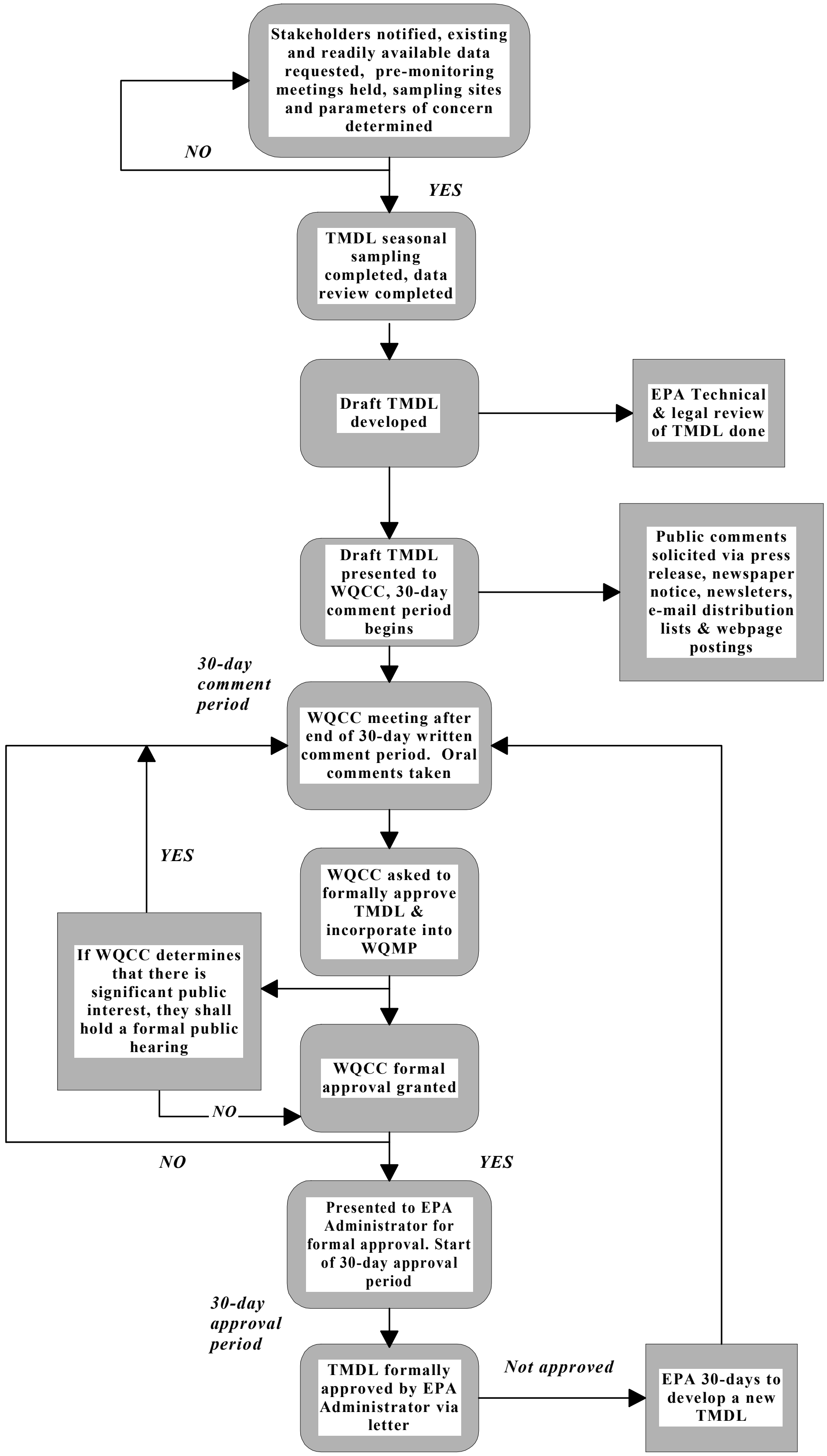
6). Check the appropriate box(s) on the field sheet for source(s) of nonsupport and estimate percent contribution of each source.

7). Photodocument probable source(s) of pollutant.

8). Create a folder for the TMDL files, insert field sheet and photodocumentation into the file.

This information will be used to update §303(d) Lists and the States §305(b) Report to Congress.

Appendix J Public Participation Flowchart



Appendix J

To be completed